

<b>Notice of Allowability</b>	<b>Application No.</b>		<b>Applicant(s)</b>	
	09/787,029		HIRANO, TAKUYA	
	<b>Examiner</b>		<b>Art Unit</b>	
	Ponnoreay Pich		2135	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 5/1/2007.
2. ☒ The allowed claim(s) is/are 15-24.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☒ All    b) ☐ Some\*    c) ☐ None    of the:
    1. ☒ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
  - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached
    - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.
  - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. <input type="checkbox"/> Notice of References Cited (PTO-892)</li> <li>2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)</li> <li>3. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br/>Paper No./Mail Date _____</li> <li>4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br/>of Biological Material</li> </ol> | <ol style="list-style-type: none"> <li>5. <input type="checkbox"/> Notice of Informal Patent Application</li> <li>6. <input type="checkbox"/> Interview Summary (PTO-413),<br/>Paper No./Mail Date _____</li> <li>7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment</li> <li>8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance</li> <li>9. <input type="checkbox"/> Other _____</li> </ol> |
|---|---|

### EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Thomas Brown (Reg. No. 44,450) on 7/11/2007. The amendments are to fix minor objections and to cancel non-elected claim 1. As the substance of the interview has been summarized herein, a separate interview summary form will not be provided (MPEP 713.04).

The application has been amended as follows:

#### IN THE CLAIMS:

Claim 1 (cancelled).

Claim 15 (Currently Amended): In quantum cipher communication using a light signal, a quantum cipher communication system, which comprises a sender's apparatus, a recipient's apparatus and a transmission path connecting between said sender's apparatus and said recipient's apparatus, and is characterized in that said sender's apparatus comprises:

a light source for a laser beam;

a beam splitting means for splitting said laser beam into said a weak signal light and said an intense reference light;

Art Unit: 2135

a phase modulation means for imparting, a phase change on either said weak signal light or said intense reference light for every light of said laser beam and

a light attenuation means for attenuating said weak signal light intensity,

said recipient's apparatus comprises:

a phase modulation means for imparting a phase change on either said weak signal light or said intense reference light for said every light transmitted from said sender's apparatus through said transmission path;

a superimposing means for superimposing said weak signal light and said intense reference light, either of which is phase changed by said phase modulation means of said recipient's apparatus;

a pair of photoconductive diodes for converting two output lights from said superimposing means into respective electric signals; and

an amplifying means for amplifying a difference signal between said respective electric signals as said difference signal,

wherein ~~said~~ a sender, by using said phase modulation means of said sender's apparatus, imparts to either of said weak signal light or said intense reference light a phase change randomly selected from a set of phase changes predetermined by said sender and ~~said~~ a recipient for said every light, and said recipient, by using said phase modulation means of said recipient's apparatus, imparts to either of said weak signal light or said intense reference light a phase change

randomly selected from said set of phase changes for said every light, as well as measures said difference signal between said electric signals amplified by said amplifying means;

then, by using a public communication line, said recipient notifies said sender of said phase changes imparted by said recipient;

said sender calculates a total phase difference between said weak signal light and said intense reference light by adding said phase change made and notified by said recipient and said phase change made by said sender, and notifies said recipient of each a light whose total phase difference satisfy a total phase condition predetermined by said sender and said recipient, as a raw key candidate for being adopted as a privacy key;

then said recipient, for said each light notified as said raw key candidate, assigns bit 1 or bit 0 by comparing said difference signal thereof with threshold values  $+X$  and  $-X$ , as assigning bit 1 when said difference signal thereof is equal or greater than said threshold value  $+X$ , and assigning bit 0 when said difference signal thereof is equal or less than said threshold value  $-X$ , whereby said recipient gets a privacy key;

said sender, for said each light notified as said a raw key candidate, assigns bit 1 or 0 according to a condition regarding said total phase difference, which is predetermined by said sender and said recipient, whereby said sender gets a privacy key;

wherein said threshold values  $+X$  and  $-X$  are determined from said a quantum-

mechanical probability distribution;

wherein said eavesdropping is detected by said recipient measuring a change in a said quantum-mechanical probability distribution; and  
wherein said sender and said recipient can get a privacy key in common with suitable effective detection efficiency and suitable error rate by selecting said threshold values  $+X$  and  $-X$ .

Claim 17 (Currently Amended): In quantum cipher communication using a light signal, a quantum cipher communication system as set forth in claim 15, characterized in that said sender's apparatus further comprises:

- said light source for a linearly polarized pulsed light;

- a beam splitter for splitting said linearly polarized pulsed light into said weak signal light and said intense reference light as said beam splitting means;

- a first long optical path comprising a half wave plate for rotating the polarization of said signal light by 90 degrees, a light attenuator for attenuating said weak signal light intensity as said light attenuating means, a phase modulator making said weak signal light a phase change for every light of said linearly polarized pulsed light as said phase modulation means of said sender's apparatus, and mirrors; and

- a first polarized beam splitter for returning said weak signal light transmitted through said first long optical path and said intense reference light

onto a common optical axis, wherein said weak signal light and said intense reference light returned to said common optical axis have a mutual time delay based on the optical path length difference between said first long optical path for said weak signal light and a first short optical path where said intense reference signal reaches to said first polarized beam splitter from said beam splitter, and have mutually orthogonal polarizations,

an optical fiber comprising a single mode optical fiber connected to said first polarized beam splitter, wherein said weak signal light and said intense reference light are transmitted there-through, keeping said mutual time delay and said mutually orthogonal polarizations,

said recipient's apparatus further comprises:

a second polarized beam splitter for splitting said weak signal light and said intense reference light transmitted through said optical fiber;

a second long optical path comprising a half wave plate for rotating the polarization of said intense reference light transmitted through said optical fiber, and mirrors, and a second short optical path comprising a phase modulator for imparting a phase change on said weak signal light for said every light transmitted through said optical fiber as said phase modulation means of said recipient's apparatus, wherein the time delay based on the optical path length difference between said second short optical path and said second long optical path of said recipient's apparatus has the same absolute value and opposite sign to said mutual time delay in said sender's

Art Unit: 2135

apparatus;

a third polarized beam splitter for superimposing said weak signal light transmitted through said second short optical path and said intense reference light transmitted through said second long optical path as said superimposing means;

said pair of photoconductive diodes for converting two output lights from said third polarized beam splitter into said respective electric signals; and

an amplifier for amplifying a difference signal between said respective electric signals as said amplifying means,

said set of phase changes are 0,90,180, and 270 degrees, and

said total phase condition is either 0 or 180 degrees.

The following is an examiner's statement of reasons for allowance: The prior art did not teach the method used by the sender's apparatus and receiver's apparatus to come to agreement on a privacy key as recited in the system of independent claim 15. The method is defined beginning on the first wherein clause in claim 15.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

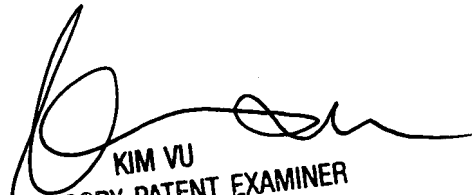
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ponnoreay Pich whose telephone number is 571-272-7962. The examiner can normally be reached on 9:00am-4:30pm Mon-Thurs.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kim Vu can be reached on 571-272-3859. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PP

Ponnoreay Pich  
Examiner  
Art Unit 2135



KIM VU  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2100